

Quarterly  
Report

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PROGRESS REPORT

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Title: Evaluation of Spatial, Radiometric  
and Spectral Thematic Mapper Performance  
for Coastal Studies

Principal Investigator: Dr. V. Klemas  
College of Marine Studies  
University of Delaware  
Newark, Delaware 19716  
302/451-2336

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Technical Monitor:

H. Oseroff → 602  
Code 902, Building 16, Room G8A  
NASA Goddard Space Flight Center  
Greenbelt, Maryland 20771

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(NASA-CR-177149) EVALUATION OF SPATIAL,  
RADIOMETRIC AND SPECTRAL THEMATIC MAPPER  
PERFORMANCE FOR COASTAL STUDIES Quarterly  
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1. Problems

The primary problem of obtaining cloud-free data has been overcome by two excellent passes: Path/Row 14/33 (Delaware Bay test site) on 21 September 1984; and Path/Row 14/34 (Chesapeake Bay test site) on 19 July 1984. After inspecting the images, tapes have been ordered for both dates.

2. Accomplishments

Analysis of ground-gathered Thematic Mapper data is continuing. The main emphasis of the research was to determine what effect different wetland plant canopies would have upon observed reflectance in Thematic Mapper bands. The three major vegetation canopy types (broadleaf, gramineous and leafless) produce unique spectral responses for a similar quantity of live biomass. Biomass estimates computed from spectral data were most similar to biomass estimates determined from harvest data when models developed for a specific canopy were used. In other words, the spectral biomass estimate of a broadleaf canopy was most similar to the harvest biomass estimate when a broadleaf canopy radiance model was used. Work is continuing to more precisely determine regression coefficients for each canopy type and to model the change in the coefficients with various combinations of canopy types. We suspect that textural and spatial considerations can be used to identify canopy types and improve biomass estimates from Thematic Mapper data. We expect to test these models when the 21 September 1984 TM tape for P/R 14/33 arrives.

As noted in previous progress reports, we have also classified two subscenes of TM imagery believed to include significant amounts of Submerged Aquatic Vegetation (SAV). The first image classified was of Broad Creek, Maryland, just north of the Choptank River. The second image classified was of Vaucluse Shores/Hungars Creek, located in the southern portion of Chesapeake, north of the Bay Bridge Tunnel. In both cases, the classification resulted in moderate success. However, in the Vaucluse Shores image, the classifier frequently misclassified SAV as deep water and vice versa. We are presently attacking this problem by including spatial clues within the classification depth. We continue to refine our radiative transfer models describing volume reflectance of eight water columns containing SAV. The modeling efforts are progressing nicely, and we anticipate concluding that phase of the research by the end of this fall.

3. Significant Results

A preliminary comparison of Landsat MSS, TM and simulated SPOT data for coastal application was presented at several symposia (see Publications section). Basically, the better spatial resolution of TM and SPOT offer major improvement for detecting many features in the coastal zone which tend to be narrow and long. This includes beds of submerged aquatic vegetation, submerged sand bars, pollution plumes, plots of marsh vegetation, etc. The Thematic Mapper offers additional improvements

due to its superior spectral bands. TM band 1 is particularly important to studies of water properties and submerged features, while TM band 7 is very sensitive to moisture content of vegetation, which can be used as an indicator of plant vigor or stress. We have also found that all major wetland vegetation species can be clearly discerned in TM imagery. The spatial resolution of TM data appears to be better than 30 meters, i.e., it seems to be closer to 25 meters than 30 meters.

Based on the three morphologic wetland canopy types, simple regression models were developed equating the vegetation index and the infrared index with biomass. Spectral data were collected with the hand-held radiometer from the ground and from a low altitude aircraft. Sampling points were arranged on a 30 m grid with actual harvesting of vegetation conducted after the radiance data were collected. With the vast majority of spectral radiance index and model combinations, the spectral radiance index estimates of total live biomass were not significantly different from the harvest biomass estimates. The species combination models for the vegetation and infrared indices were particularly good, with the all-species models being the best models for use with all three spectral radiance indices. The MSS vegetation index estimates were very similar to the vegetation index estimates. This is not surprising considering both indices contain essentially the same spectral information.

#### 4. Publications

Ackleson, S. G. and V. Klemas. "Assessing Landsat TM and MSS Data for Detecting Submerged Plant Communities", Landsat-4 Early Results Symposium, NASA Goddard Space Flight Center, 23-24 February 1983.

Hardisky, M. A. and V. Klemas. "Remote Sensing of Coastal Wetlands Biomass Using Thematic Mapper Wavebands", Landsat-4 Early Results Symposium, NASA Goddard Space Flight Center, 24-23 February 1984.

Klemas, V. "Comparison of Landsat MSS and TM for Coastal Zone Applications", Landsat D' Launch User Symposium, Santa Barbara, CA, 27 February - 1 March 1984.

Ackleson, S. G. and V. Klemas. "Remote Reconnaissance of Submerged Aquatic Vegetation: A Radiative Transfer Approach", Third Landsat-4 Workshop, NASA Goddard Space Flight Center, Greenbelt, MD, 6-7 December 1983.

Hardisky, M. A. and V. Klemas. "Aboveground Biomass Estimation In a Tidal Brackish Marsh Using Simulated Thematic Mapper Spectral Data", NASA Goddard Space Flight Center, Greenbelt, MD, 6-7 December 1983.

Klemas, V. "The Use of Remote Sensing in Estuarine and Coastal Resources Management", NOAA Environmental Satellite User Symposium, Washington, DC, 26-28 March 1984.

Klemas, V. "Remote Sensing of Coastal and Ocean Properties", SPIE - International Society for Optical Engineering Technical Symposium East '84, Washington, DC, 29 April - 4 May, 1984.

Ackleson, S. G., V. Klemas, H. L. McKim, and C. J. Merry. "A Comparison of SPOT Simulator Data with Landsat MSS Imagery for Delineating Water Masses in Delaware Bay, Broadkill River, and Adjacent Wetlands, 1984 SPOT Symposium, Scottsdale, AZ, 20-23 May 1984.

Hardisky, M. A., F. C. Daiber, C. T. Roman, and V. Klemas. 1984. Remote sensing of biomass and annual net primary productivity of a salt marsh. Remote Sensing of Environment 16: 91-106.

#### 5. Recommendations

Increase the number of TM tapes provided to investigators.

#### 6. Funds Expended

Approximately \$50,000 have been expended during the first eighteen months of the contract. The total project budget is \$58,583.

#### 7. Data Utility

Discussions have been initiated with NOAA and EPA to use TM data to map submerged aquatic vegetation and water quality in Chesapeake Bay.

A joint project is being developed with the Maryland Department of Natural Resources Tidewater Administration to use Landsat TM for monitoring environmental changes in estuarine sanctuaries in Chesapeake Bay.

The Delaware State Highway Department is interested in using Landsat data for planning new highway corridors. This is an outgrowth of our work using Landsat data for developing and testing archeological predictive models, which are able to predict the potential location of historic Indian sites with a factor 2 better than any other available technique.

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